



2005-06 Ringold Springs Hatchery Steelhead Return and Harvest

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Recent History of Ringold Steelhead Fishery

The National Marine Fisheries Service (NMFS) listed Upper Columbia steelhead as an "endangered" species and Snake River wild steelhead as "threatened" in August, 1997 under the Endangered Species Act (ESA) of 1973. Mid-Columbia steelhead, which include Yakima Basin steelhead, were listed in March, 1999, as "threatened". Region 3, District 4 fisheries that potentially impact listed steelhead include the Columbia River steelhead sport fishery, the Hanford Reach fall chinook fishery, Yakima Basin trout and salmon fisheries, and the Columbia River sturgeon, walleye, bass, and panfish fisheries.

With the endangered listing for both hatchery and wild Wells steelhead (Upper Columbia ESU), adult steelhead returning to the Ringold Springs Rearing Facility (RSRF) are used as an "ESU-reserve stock". This "reserve population" will be used for broodstock purposes in the event the numbers of fish required above Priest Rapids Dam cannot be met due to poor survival or a catastrophic loss. Steelhead reared and released at the RSRF originate from early egg takes at Wells Hatchery. Smolts released from RSRF are adipose and right ventral clipped to identify them as the Ringold steelhead "ESU-reserve" population. Adult steelhead in excess of reserve population broodstock needs provide recreational fishing opportunity in the lower 23 miles of the Hanford Reach and the lower Columbia River. The fishery boundary area is from the Highway 12/395 Bridge at Pasco (RM 330) upstream to the old Hanford town site power line crossing (RM 362).

The Ringold area hatchery steelhead fishery was listed as a permanent rule in the **Fishing in Washington Sport Fishing Rules** in 2003. The fishery is open from October 1 through April 15 of the following year. This fishery is open for bank and boat angling through March 31, but is restricted to "bank fishing only" from April 1 through April 15 to reduce impacts to ESA listed spring chinook. The boundary area for the bank fishery is from the WDFW marker ¼ mile downstream of the Ringold irrigation wasteway outlet to the marker ½ mile upstream of Spring Creek. Anglers are only permitted to harvest hatchery steelhead with both an adipose fin-clip and a ventral fin-clip during the month of October and can harvest any hatchery steelhead after October 31. Daily limit is two steelhead. This fishery was opened by emergency regulation and with varying start dates in years' prior pending approval from National Oceanographic and Atmospheric Administration (NOAA) Fisheries.

RSRF Hatchery Steelhead Return Estimates

Wells stock steelhead were first released from Ringold Springs in the spring of 1998. The first release was 200,000 smolts from the 1997 brood year. The return of Wells stock steelhead to the RSRF in 1999 was estimated at 3,154 fish, generating a smolt to adult return rate (SAR) of 0.01577 for 1-salt returns. The 1999 return was the only year that a complete enumeration of returns at the facility has occurred. Operational procedures at the Ringold facility have not been structured to provide information for the determination of a SAR for 2-salt returns for Wells stock at the facility. Sport fishing surveys conducted prior to the fall of 2001 collected limited information on age composition of the return. From the 2001-02 through the 2004-05 fishery, scale samples were collected from 50% of the steelhead in the creel survey. Based on data from the creel surveys, roughly 21% (range: 4.1% - 27.3%) of the escapement returned to Ringold as 2-salt age steelhead. The 2003-04 season was excluded due to the unusually large component of 1-salt steelhead. Using the 1999 return of 3,154 as a base for calculation of an SAR and an age composition of 0.2133 for 2-salt returns (mean 2001-04 sport fisheries) an estimated 856 age 2-salt steelhead would return from the 1997 brood year, generating an SAR of 0.004275 for the 1999 return. No age 3-salt Wells stock steelhead have been sampled in the sport fishery at Ringold, consequently, no 3-salt steelhead are included in the return estimates.

The Ringold facility has released between 80,520 and 210,000 steelhead annually during the seven years it has reared and released Wells stock (Table 1). RSRF released 106,147 juvenile steelhead in 2004 (BY 2003) and 80,520 juvenile steelhead in 2005 (BY 2004). With an SAR of .004275 for 2-salt steelhead returns, 454 2-salt adults are expected to return to Ringold in 2006. Using the SAR established in 1999 (0.01577), 1,270 1-salt steelhead are estimated to return in 2006 giving a total estimated return of 1,724 steelhead (Table 2).

Table 1. Juvenile steelhead releases of Wells hatchery steelhead from RSRF and expected adult returns by Brood Year, 1997 - 2004.

Brood Year	Smolts Released	Expected Return for Broodyear		
		1-salt	2-salt	Total
2004	80,520	1,270	344	1,614
2003	106,147	1,674	454	2,128
2002	171,645	2,707	734	3,441
2001	164,556	2,595	703	3,298
2000	210,000	3,312	898	4,210
1999	181,000	2,854	774	3,628
1998	181,000	2,854	774	3,628
1997	200,000	3,154	855	4,009

Table 2. Annual return estimates for Ringold Springs Rearing Facility, 1999-2006.

Year	Estimated Return		
	1-salt	2-salt	Total
2006	1,270	454	1,724
2005	1,674	734	2,408
2004	2,707	703	3,410
2003	2,595	898	3,493
2002	3,312	774	4,086
2001	2,854	774	3,628
2000	2,854	855	3,709
1999	3,154		3,154

Sport Harvest Sampling

The Columbia River from the Highway 395 bridge in Pasco to the wooden power line towers near the old Hanford townsite was open for the retention of hatchery steelhead from October 1, 2005 through April 15, 2006. Trailer counts and angler interviews were conducted at the Ringold and Hanford Monument Parking Lot 7 primitive boat launches and along the shorelines at the WDFW Ringold Access area to estimate catch, harvest, and impacts to ESA listed species during the Ringold steelhead fishery. Daily creel and effort sampling was stratified into four separate components to generate an accurate estimate of total effort, catch, and harvest: (1) weekday bank anglers, (2) weekday boat anglers, (3) weekend bank anglers, and (4) weekend boat anglers. Angler counts were converted to angler-hours by multiplying the mean hourly angler count by the number of angling hours in a day (Hahn et al 1993). Angling hours was defined as the number of daylight hours plus one hour. For the month of October, daily boat angler effort was expanded by 25% to account for boats launching from Tri-cities area boat launches that are largely non-sampled. This expansion was decreased to 10% from November through March as relatively few boat anglers use the Tri-cities area launches to pursue steelhead after the fall chinook fishery declines and the weather grows cooler.

During the fall chinook fishery in the Hanford Reach (August 16 - October 22), trailer counts and creel interviews are also conducted at Leslie Groves Park, White Bluffs boat launch, and the Vernita Bridge boat launches. As these two fisheries overlap within the Ringold area of the Columbia River, all impacts to ESA listed species (mid-Columbia steelhead) prior to October 1 and outside of the immediate Ringold area after October 1 are excluded from the Ringold steelhead fishery impacts and are calculated and reported as impacts resulting from the fall chinook fishery.

Interviews were conducted on 87 of the 197 days of the fishery, October 1 - April 15. Sampling dates were randomly selected. A total of 2,298 anglers were interviewed; 1,224 bank anglers and 1,074 boat anglers.

Angler Activity and Effort

Anglers spent an estimated 35,317 hours fishing for steelhead in the Ringold area of the Columbia River during the 2005-06 fishery (Table 3). This was a 15% decline in effort compared to the 2004-05 fishery. WDFW staff sampled 28.3% of the estimated effort during this fishery (Table 4).

Approximately 71% of the effort occurred during October. The increased effort during the first month of the season can be largely attributed to the Ringold steelhead season coinciding with the Hanford Reach fall chinook fishery. Anglers are largely targeting on fall chinook in October but regularly harvest steelhead. There was no effort to segregate anglers by target species due to the large overlap in effort for both species. Boat anglers comprised 70% of the angling effort (Table 5). This was largely due to the high level of boat effort during the October fall chinook fishery. From November 1 through April 15, bank anglers contributed 64% of the effort.

Table 3. Comparison of angler effort during the Ringold steelhead fishery, October 1, 2005 through April 15, 2006.

	Season		October		Nov - Apr	
	Angler Hours	%	Angler Hours	%	Angler Hours	%
Bank	10,651	30.2%	4,029	16.1%	6,622	64.3%
Boat	24,666	69.8%	20,997	83.9%	3,669	35.7%
Total	35,317		25,027	70.9%	10,291	29.1%
Weekday	18,903	53.5%	12,984	51.9%	5,919	57.5%
Weekend	16,415	46.5%	12,043	48.1%	4,372	42.5%

Table 4. Estimated total effort, angler hours sampled, and percent of total effort sampled by month during the 2005-06 Ringold steelhead fishery.

Month	Effort (Angler Hours)		
	Total Effort (hours)	Sampled (#)	Sampled (%)
October	24,867	6,362	25.6%
November	3,843	1,831	47.7%
December	1,052	514	48.9%
January	748	309	41.4%
February	1,043	310	29.8%
March	2,804	565	20.1%
April	792	41	5.2%
Total	35,148	9,933	28.3%

Table 5. Summary of angler interviews by weekday, weekend, bank, and boat (Oct 1, 2005 - April 15, 2006).

	Type	Interviews		Hours Fished
		Boats	Anglers	
Weekdays	Bank		602	1,806
	Boat	223	479	2,750
	Total	223	1,081	4,556
Weekends	Bank		622	1,975
	Boat	251	595	3,403
	Total	251	1,217	5,377
Combined	Bank		1,224	3,780
	Boat	474	1,074	6,153
	Total	474	2,298	9,933

Harvest

An estimated 1,526 steelhead were caught during the 2005-06 Ringold steelhead fishery with a 95% confidence interval of 1,346 to 1,702 (± 178 fish) (Table 6 & Appendix A). Harvest was estimated at 1,069 hatchery steelhead with a 95% confidence interval of 920 to 1,211 steelhead (± 146 steelhead). This was a 35% decrease in the catch and a 41% decline in harvest compared to the 2004-05 fishery (Table 7). Catch and effort was highest during October and March. Ringold reared steelhead comprised 81% of the catch and 87% of the harvest. Released steelhead included, 307 adipose + right vent clipped (Ringold) steelhead, 68 adipose only clipped steelhead, and 84 wild steelhead. Harvest was restricted to Ringold origin steelhead until November 1.

Table 6. Monthly summary of Ringold steelhead fishery catch and harvest, October 1, 2005 – April 15, 2006.

Month	Total		ADRV		AD		Wild		Recycle	
	Catch	Harvest	Catch	Harvest	Catch	Harvest	Catch	%	Catch	Harvest
October	438	348	352	344	52	4	34	7.8%	0	0
November	251	236	216	211	25	25	10	4.0%	2	1
December	96	53	54	45	11	8	31	32.3%	0	0
January	53	49	39	37	12	12	2	3.8%	7	0
February	90	53	57	29	30	24	3	3.3%	7	4
March	445	215	369	154	72	61	4	0.9%	0	0
April	154	114	154	114	0	0	0	0.0%	0	0
Total	1,527	1,069	1,241	934	202	134	84	5.5%	16	5

Table 7. Annual season, catch, harvest, and angler effort during Ringold steelhead fishery, 2001-2006.

Year	Season	Catch	Harvest	CPUE	HPUE	Est. Pole Hours
2005-06	Oct. 1 – April 15	1,527	1,069	0.043	0.030	35,318
2004-05	Oct. 1 – April 15	2,347	1,825	0.057	0.044	41,359
2003-04	Oct. 1 – April 15	4,267	2,698	0.095	0.060	45,070
2002-03	Oct. 12 – April 15	2,036	1,333	0.094	0.062	21,633
2001-02	Nov. 16 – June 15	1,931	1,764	0.116	0.106	16,648

The mean catch per unit effort (pole hours) was 0.043 for the 2005-06 fishery, 23.2 hours fished per steelhead. Harvest per unit effort (HPUE) was 0.030 steelhead per pole hour. CPUE was highest in April with a steelhead caught for each 5.2 hours of angling (Table 8). Catch and harvest during the 2005-06 fishery was the lowest recorded since the RSRF began releasing Wells origin steelhead. Only one hatchery steelhead was recorded harvested from a boat having launched at a site other than Ringold. It was reported on October 22 (last day of salmon season) at the White Bluffs boat launch.

Table 8. Summary of monthly effort (angler hours), catch, and CPUE, 2005-06 Ringold steelhead fishery.

	Angler Hours	Harvest	CPUE	Hours per Fish		Angler Hours	Harvest	CPUE	Hours per Fish
	October					February			
Bank	4,030	256	0.064	15.7	Bank	630	45	0.071	14.0
Boat	20,997	180	0.009	116.6	Boat	412	46	0.112	9.0
Overall	25,027	436	0.017	57.3	Overall	1,043	91	0.087	11.5
	November					March			
Bank	2,379	107	0.045	22.2	Bank	1,686	249	0.148	6.8
Boat	1,464	144	0.099	10.1	Boat	1,127	196	0.174	5.7
Overall	3,843	251	0.065	15.3	Overall	2,813	445	0.158	6.3
	December					April			
Bank	606	31	0.052	19.3	Bank	792	153	0.1933	5.2
Boat	447	64	0.144	7.0	Boat				
Overall	1,052	96	0.091	11.0	Overall	792	153	0.1933	5.2
	January					Season			
Bank	529	10	0.019	52.9	Bank	10,651	852	0.0800	12.5
Boat	219	43	0.196	5.1	Boat	24,666	674	0.0273	36.6
Overall	748	53	0.071	14.1	Overall	35,318	1,526	0.0432	23.2

An estimated 84 wild steelhead were caught and released during this sport fishery. Wild steelhead comprised 5.5% of the catch. Based on a hooking mortality rate of 5%, 4 wild steelhead mortalities were associated with this fishery. The number of wild steelhead caught and released has ranged from 84 to 212 (2002-03) over the last five years of this fishery, with an interception rate of 3.5% (2003-04) to 10.4% (2002-03) of the catch. Mortality due to hook and release associated with this fishery has ranged from 4 to 11 steelhead. WDFW Detachment 19 accumulated over 60 hours towards steelhead/salmon enforcement in the Hanford Reach including several boat patrols between October 2005 and April 2006.

Comparison of Estimated Harvest versus Catch Record Card Estimates

Steelhead harvest within the area of the Columbia River from the Highway 395 bridge (Tri-cities) to the wooden powerline towers at the old Hanford townsite is estimated in-season through angler interviews. In addition to in-season estimates, WDFW requires licensed anglers to file catch record cards for steelhead, salmon, and sturgeon harvested. These Catch Cards are voluntarily submitted to WDFW after March 31 of each year. The catch cards are used to estimate harvest by area for the license season (April through March). Comparisons can then be made between in-season estimates and catch record card estimates; or catch record card information can be used where in-season estimates are not available. Angler harvest estimates based on catch record cards is commonly released to State biologists in the fall. The WDFW District 4 biologist reviews the catch card data for the Ringold area steelhead fishery, Hanford Reach summer chinook fishery, Hanford Reach fall chinook fishery, and the Yakima River salmon fishery.

Harvest estimates based on angler interviews and catch record cards were relatively similar during the 2002-03 and 2003-04 Ringold steelhead sport fisheries during October, November, and for the overall harvest (Tables 9, 10, 11, 12 & Figures 1, 2, 3). With the exception of October, the 2004-05 in-season estimates were significantly lower than the catch record card estimates (Tables 12 & Figures 3). Catch record card harvest estimates of the 2005-06 Ringold steelhead sport fishery were not available at the time of this report and comparisons will be detailed in the 2006-07 annual report. In general, monthly comparisons between the two methods for estimating harvest tend to be very similar in October and November, the months with the highest angler activity and associated harvest, and more variable from December through April. This is not surprising as HPUE and angler effort is extremely variable during the winter months. In addition, only part-time staff is available to conduct creel surveys from December through April (Angler effort sampled is maintained above 20% even during winter months).

Table 9. Comparison of estimated steelhead harvest based on WA catch record cards and creel interviews, John Day Dam to Priest Rapids Dam, October to April, 2002 - 2005.

2002-03	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Catch Card	335	407	171	124	149	150	23	1,359
Creel	334	368	111	101	298	98	23	1,333
2003-04								
Catch Card	822	806	266	179	247	461	76	2,857
Creel	830	994	121	73	273	359	48	2,698
2004-05								
Catch Card	961	608	221	143	191	316		2,440
Creel	990	415	156	19	79	111		1,770

Harvest estimates from the catch record cards may be biased as a result of the relatively few anglers fishing during the winter months or the in-season estimates may be biased due to angler activity outside of the survey areas. Steelhead, both hatchery and wild, are commonly reported harvested during closed seasons from the catch card data. The numbers of steelhead reported (and their expansions) are very low for both groups (hatchery and wild) and could be either reporting errors or anglers unaware of the current regulations for steelhead.

Table 10. Estimated steelhead harvest based on WA Catch Record Cards from John Day Dam to Priest Rapids Dam, April 2002 to March 2003.

Area		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
John Day to McNary	Hatch		13	11	4	20	42	324	531	333	352	236	59	1,925
	Wild		0	0	0	0	2	4	9	2	9	0	0	26
	Total		13	11	4	20	44	328	540	335	361	236	59	1,951
McNary to Hwy 395	Hatch	5		5	5	178	490	2,306	1,666	542	305	50	2	5,554
	Wild	0		0	0	0	12	60	49	19	10	0	0	150
	Total	5		5	5	178	502	2,366	1,715	561	315	50	2	5,704
Hwy 395 to Hanford	Hatch	77	5			2	19	335	407	171	124	149	150	1,439
	Wild	0	0			0	3	20	3	0	10	5	7	48
	Total	77	5			2	22	355	410	171	134	154	157	1,487
Hanford to Priest	Hatch				5		23	9	27		5	5		74
	Wild				0		0	0	0		0	0		0
	Total				5		23	9	27		5	5		74

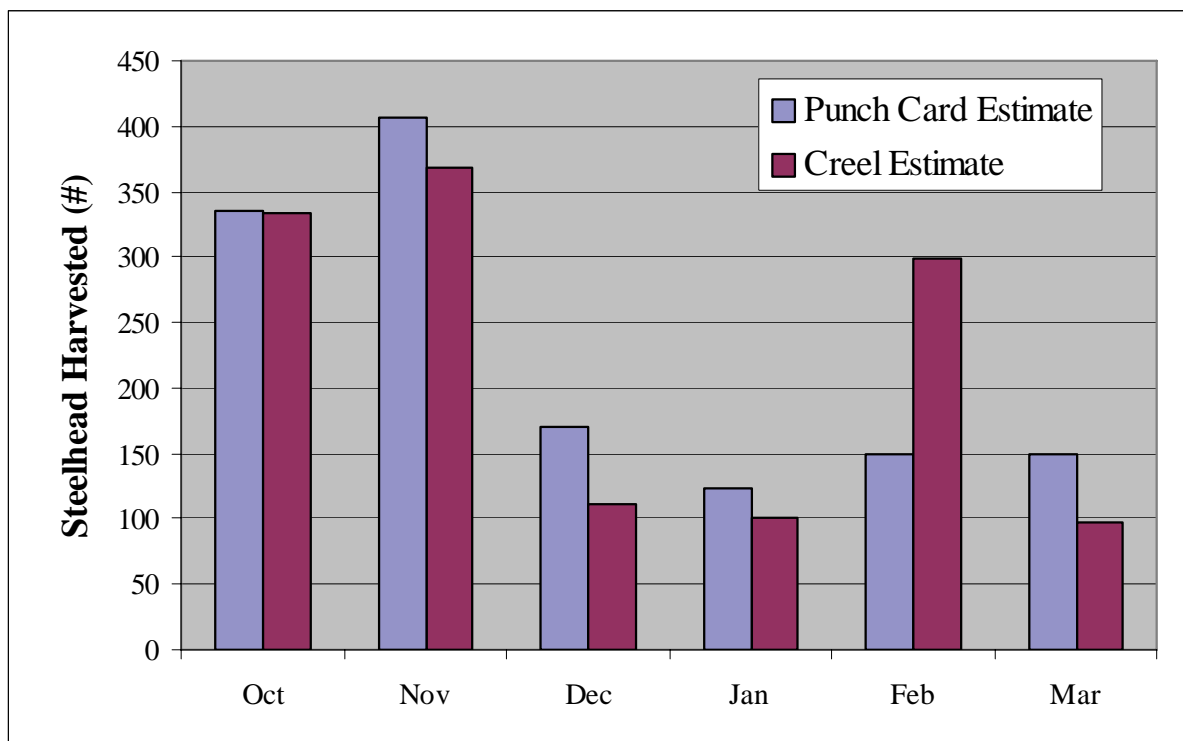
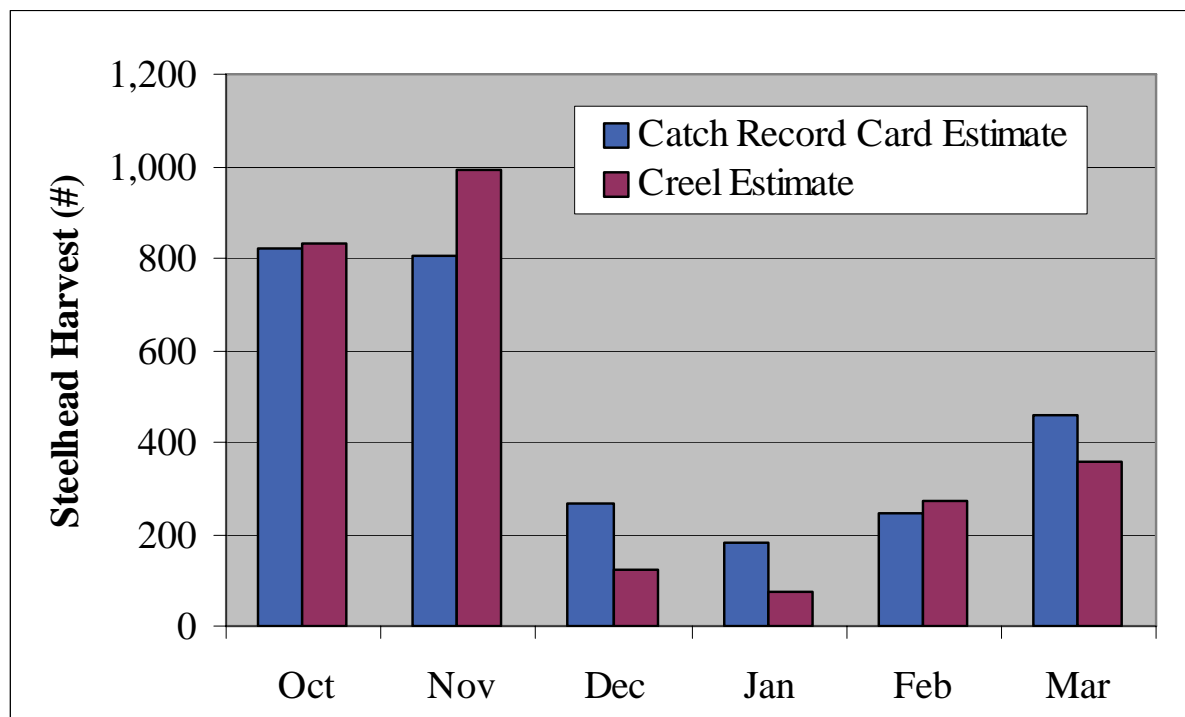


Figure 1. Comparison of steelhead sport harvest as calculated from creel interviews and license punch card data, Hwy 395 bridge to Hanford Townsite, October 2002 - March 2003.

Table 11. Estimated steelhead harvest based on WA license punch cards from John Day Dam to Priest Rapids Dam, April 2003 to March 2004.

Area		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
John Day to McNary	Hatch	11	2	4	29	13	7	59	167	250	135	211	176	1,064
	Wild	0	0	0	0	0	2	4	6	0	7	6	4	29
	Total	11	2	4	29	13	9	63	173	250	142	217	180	1,093
McNary to Hwy 395	Hatch	2			18	27	287	513	392	214	61	95	65	1,674
	Wild	0			0	0	20	12	7	7	2	0	0	48
	Total	2			18	27	307	525	399	221	63	95	65	1,722
Hwy 395 to Priest	Hatch	23			3	2	8	822	806	266	179	247	461	2,817
	Wild	0			0	0	3	13	3	0	0	3	5	27
	Total	23			3	2	11	835	809	266	179	250	466	2,844
Creel vs Punch Card	Punch	23						822	806	266	179	247	461	2,804
	Creel	23						830	994	121	73	273	359	2,673
	Diff													

Figure 2. Comparison of steelhead sport harvest as calculated from creel interviews and license



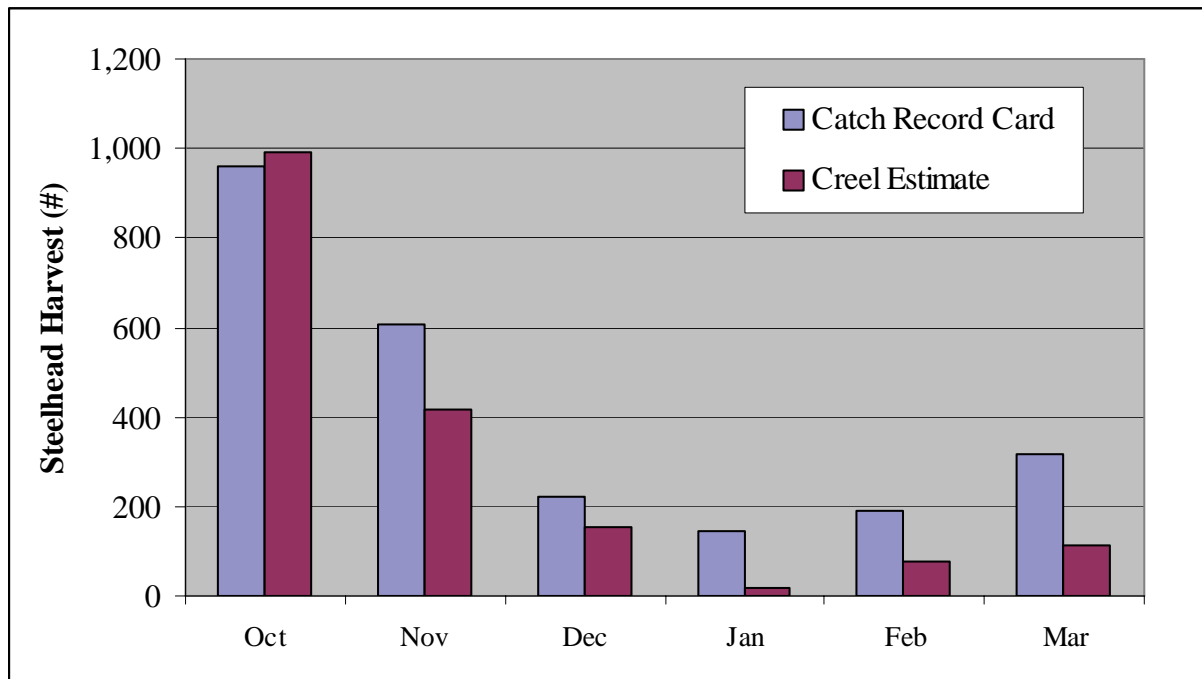
punch card data, Hwy 395 bridge to Hanford Townsite, October 2003 - March 2004.

Table 12. Estimated steelhead harvest based on WA license punch cards from John Day Dam to

Priest Rapids Dam, April 2004 to March 2005.

Area		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
John Day to McNary	Hatch	13	.	.	6	13	4	17	83	87	25	51	83	382
	Wild	0	.	.	0	0	0	0	0	0	0	0	0	0
	Total	13	.	.	6	13	4	17	83	87	25	51	83	382
McNary to Hwy 395	Hatch	2	7	.	2	9	220	248	187	97	47	40	7	866
	Wild	0	0	.	0	0	0	2	0	0	0	0	0	2
	Total	2	7	.	2	9	220	250	187	97	47	40	7	868
Hwy 395 to Priest	Hatch	76	.	.	5	.	9	961	608	221	143	191	316	2,530
	Wild	0	.	.	0	.	0	0	0	0	0	0	2	2
	Total	76	.	.	5	.	9	961	608	221	143	191	318	2,532
Creel vs Punch Card	Punch	76	.	.	5	.	9	961	608	221	143	191	316	2,530
	Creel	48						990	415	156	19	79	111	1,818
	Diff													

Figure 3. Comparison of steelhead sport harvest as calculated from creel interviews and license



punch card data, Hwy 395 bridge to Hanford Townsite, October 2004 - March 2005.

Ringold Springs Rearing Facility Adult Steelhead Transportation Program (Recycling)

The RSRF has not captured steelhead for egg production in recent years but has operated the facility trap located on Spring Creek to capture and transport steelhead. Hatchery staff typically transports and releases all adipose only clipped and wild steelhead at Parking Lot 7 of the Hanford National Monument. This launch is approximately seven miles upstream of the trap and above the upper boundary of the sport fishery. Ringold origin steelhead (adipose + right ventral fin) are transported and released downstream at boat launches in Kennewick and Richland. All Ringold origin fish captured at the trap are caudal clipped prior to transport and release to identify these fish as having entered the trap. After November 1, 2005, any hatchery steelhead was available for harvest in the Ringold area steelhead fishery and all hatchery steelhead were transported downstream. Caudal clipped steelhead returning to the RSRF receive a caudal punch to document the number of recapture events. Caudal clipped fish observed during creel sampling in the 2004-05 fishery are recorded to evaluate contributions of recycled fish to the overall harvest.

A total of 265 steelhead (including recaptures) were transported and released between October and December of 2005 (Table 13). These consisted of 255 Ringold origin steelhead, 9 adipose only steelhead, and 1 wild steelhead. Of the 197 Ringold steelhead captured at the hatchery trap, 46 were recaptured at least once (23%) and 11 were recaptured at the trap on three occasions. Only one wild steelhead was captured during capture operations at the RSRF trap in 2005.

Table 13. Summary of adult steelhead collected and marked at the RSRF, 2005.

Day & Month	Total (StHd)	Totals (recycle)			1X			2X		3X		Fall Chinook	
		Wild	Ad Rv	Ad only	Wild	Ad Rv	Ad only	Ad Rv	Ad only	Ad Rv	Ad only	Adult	Jack
Oct 20												1	
Oct 28	82	1	72	9	1	72	9					414	3
Nov 3												1,236	11
Nov 10	116	0	116	0		95		21				305	3
Nov 14												2	
Nov 15												4	
Nov 17												2	
Nov 18	67	0	67	0		30		25		11		80	
Nov 19												3	
Total	265	1	255	9	1	197	9	46		11		2,047	17

An estimated eight recycled steelhead were caught during the 2005-06 fishery (Table 14). The harvest of Ringold origin recycled steelhead for the 2004-05 fishery was estimated at five steelhead, 2.5% of the Ringold steelhead caudal clipped. Catch rates were likely higher than estimated for recycled steelhead as anglers will typically note the absence of the adipose fin but are less likely to notice or be aware of caudal clipped steelhead in the fishery. Roughly 4% of the recycled fish were caught and recycled fish comprised 0.5% of the overall catch and harvest for this fishery. No caudal- clipped, adipose-only steelhead was harvested in the fishery.

Table 14. Monthly summary of steelhead transported from the RSRF and associated catch and harvest in the fishery, 2005-06.

Month	Steelhead Transported			Recycled Steelhead		
	Upstream	Downstream				
		New	Repeat	Catch	Harvest	Harvest ¹ (%)
October	0	72		0	0	0.0%
November	0	125	57	1	1	0.5%
December	0			0	0	0.0%
January				0	0	0.0%
February				7	4	2.0%
March				0	0	0.0%
April				0	0	0.0%
Totals	0	197	57	8	5	2.5%

¹ Percentage of recycled fish harvested that were available in the fishery.

Adult Passage at Hydroelectric Projects

Passive Integrated Transponder (PIT) tags have been used since 1987 to monitor the movement and behavior of anadromous salmonids in the Columbia and Snake River basins. The Columbia Basin PIT Tag Information Systems (PTAGIS) was implemented in 1991 to manage the collection, correlation, and exchange of Columbia River Basin PIT tag data. PTAGIS encompasses dedicated data collection software, a centralized relational database management system, and standardized data descriptions and reporting processes. Since 2002, the scope of the Columbia Basin PTAGIS program was expanded to include entries for resident and semi-anadromous stocks of rainbow trout, cutthroat trout, bull trout, lamprey, sturgeon, and other fish species.

The use of PIT tags in fisheries research continues to increase each year. A three-year study was conducted by the National Marine Fisheries Service at the RSRF to compare smolt to adult survival (SAR) of in-river migrating versus transported Columbia River anadromous salmonids. The goal of the project is to provide statistically valid information on the smolt-to-adult return rates of Columbia River anadromous salmonids that migrate in-river compared to those transported around dams of the Federal Columbia River Power System (FCRPS). Steelhead were PIT tagged at the Ringold Springs Rearing Facility in 2002, 2003, and 2004 and released the following spring. In 2003, 63,758 juvenile PIT tagged steelhead were released, followed by 96,494 in 2004, and 60,971 in 2005. The fish ladders at Bonneville, McNary, Ice Harbor, and Priest Rapids Dams are equipped with PIT tag monitors. In addition to determining SARs, this data can provide passage timing information and information on migration routes/straying of fish.

Adult returns of Ringold released steelhead into the Columbia River exhibited typically A-Run timing (Figures 4 & 5). By September 15, 2005, 95% of the Ringold steelhead return had passed through the fish ladders at Bonneville Dam, whereas only 66% of the overall steelhead return had reached Bonneville (Table 15). On October 3, 18 days later, 95% of the Ringold steelhead had passed through McNary Dam with 73% of the overall steelhead return having passed McNary (Figures 6 & 7).

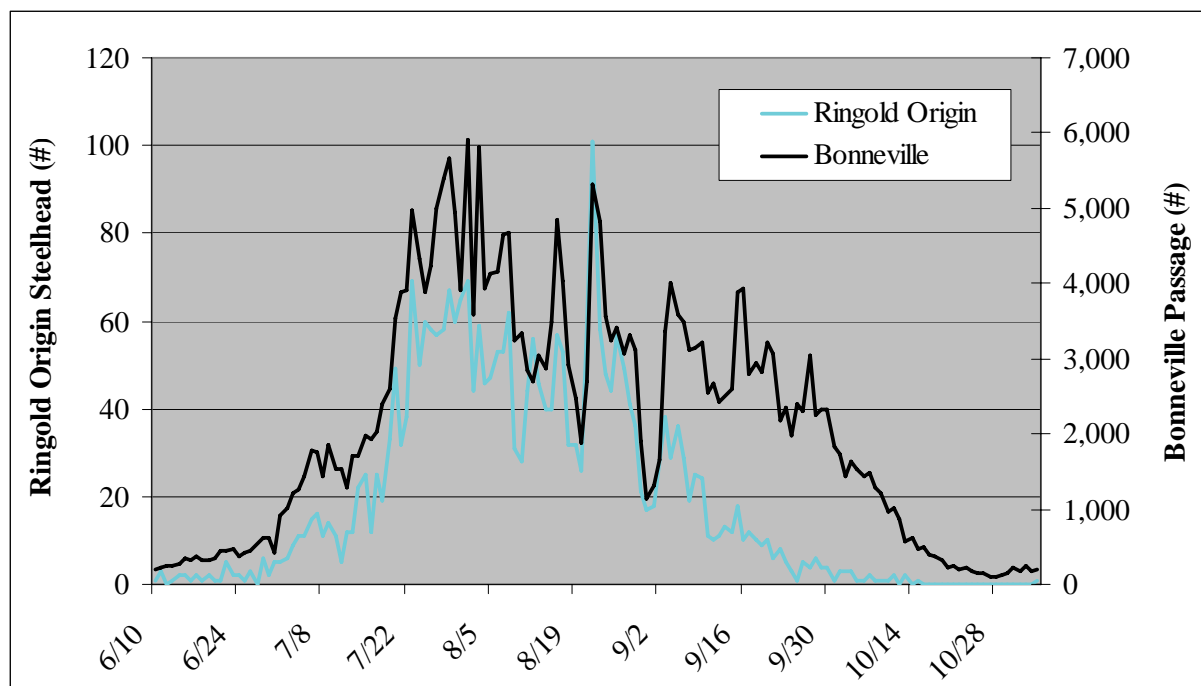


Figure 4. Adult steelhead returns through the Bonneville Fish Ladders, June 10 - November 5, 2005.

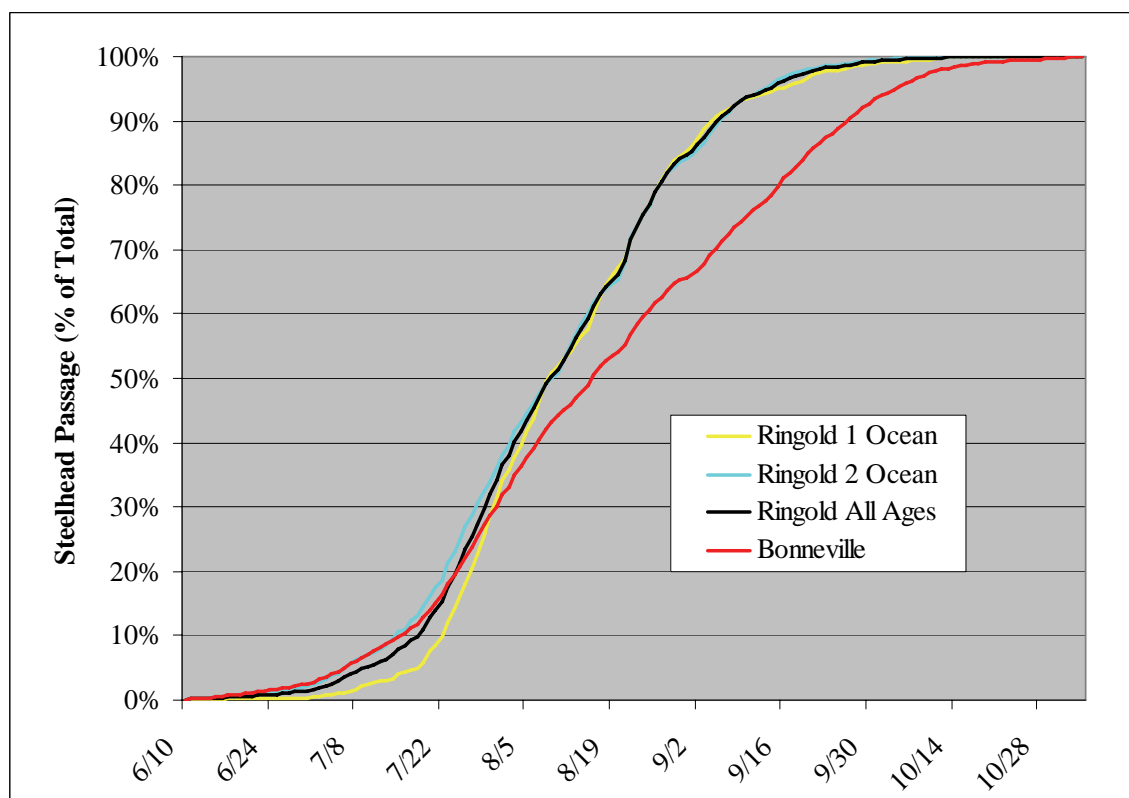


Figure 5. Run timing (% passage) of Ringold origin steelhead through the Bonneville Fish Ladders, June 10 - November 5, 2005.

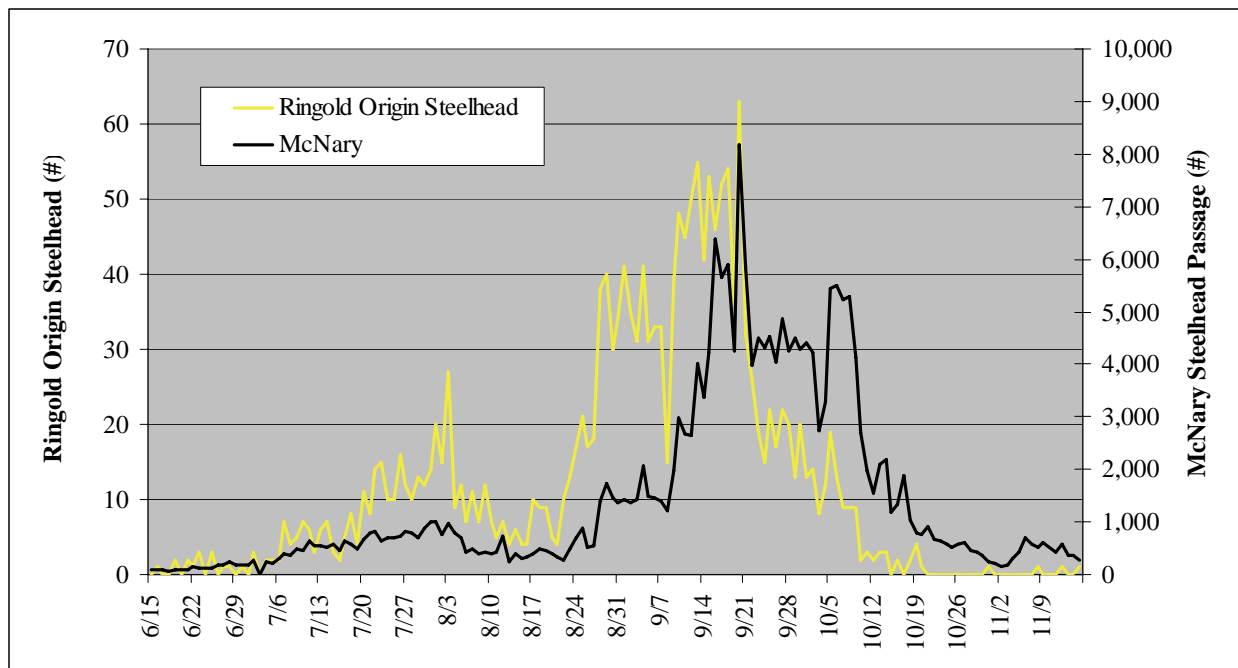


Figure 6. Adult steelhead returns through the Bonneville Fish Ladders, June 10 - November 5, 2005.

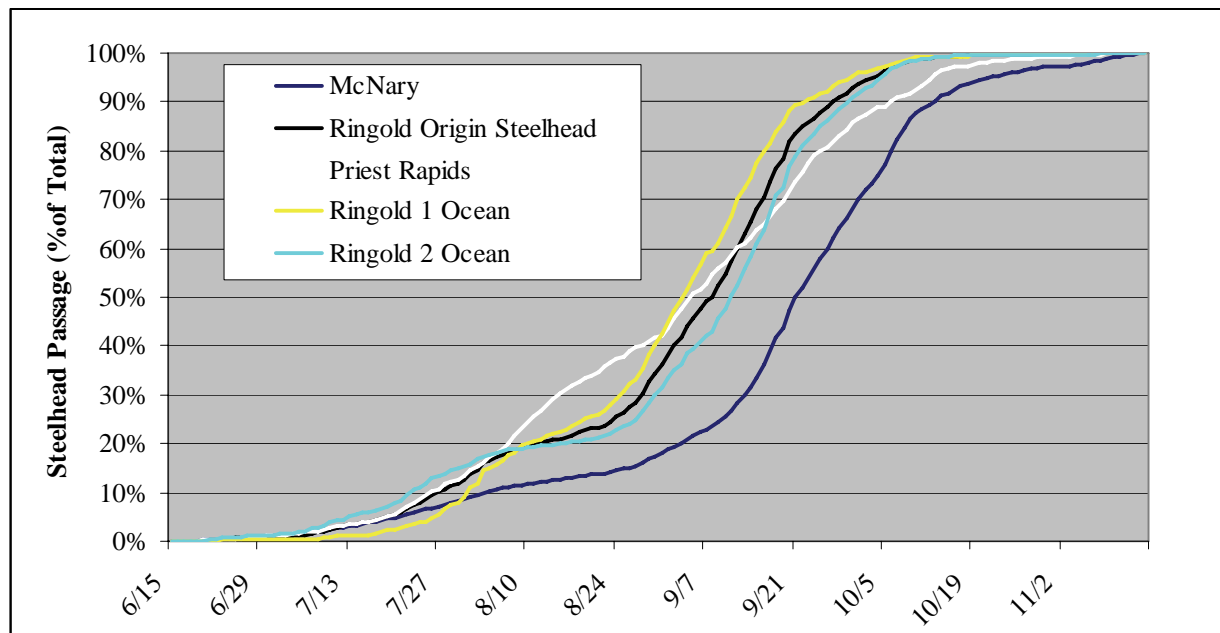


Figure 7. Run timing (% passage) of Ringold origin steelhead through the McNary Fish Ladders, June 15 - November 15, 2005.

Table 15. Comparison of passage timing of Ringold origin steelhead versus overall returns of steelhead in the Columbia River at Bonneville, McNary, and Priest Rapids fish ladders, 2005.

Date	Bonneville Fish Passage		McNary Fish Passage		Priest Rapids
	Steelhead	Ringold	Steelhead	Ringold	Steelhead
July 1	3%	1%	1%	1%	1%
July 15	9%	7%	4%	4%	4%
Aug 1	30%	34%	9%	14%	15%
Aug 15	48%	58%	13%	21%	30%
Sept 1	66%	85%	19%	38%	44%
Sept 15	79%	95%	33%	68%	64%
Oct 1	93%	99%	70%	94%	87%
Oct 15	98%	100%	92%	99%	97%

The PIT tag information can provide some indication of fish loss/harvest between detection sites. A total of 2,870 Ringold origin steelhead were detected between June 1 and November 15 at the Bonneville fish ladders in 2005. Only 1,850 PIT tagged Ringold steelhead were detected at McNary during the same time period. Harvest/steelhead loss between Projects was 35.5% in 2005 (Table 16). Steelhead loss was similar during the 2004 return with 29.1% of the steelhead detected at Bonneville unaccounted for at McNary.

Table 16. Comparison of PIT tagged Ringold origin steelhead passage from Bonneville to McNary Fish Ladders, 2004 & 2005.

Year	Bonneville	McNary	Diff	%
2005	2,870	1,850	1,020	35.5%
2004	1,859	1,318	541	29.1%
Mean				32.3%

Steelhead have been reported to roam/migrate through the reservoirs between the time they enter fresh water and begin spawning, often migrating well upstream of their spawning areas. Of the 38 PIT tagged steelhead recovered in the Ringold sport fishery creel, 8 steelhead (21%) had passed through Priest Rapids Dam prior to harvest. Based on PIT tag detections at Priest Rapids, 33% of the Ringold steelhead return passed through the fish ladders in 2005 and 12% passed through Priest Rapids in 2004 (Table 17).

Table 17. Comparison of PIT tagged Ringold origin steelhead passage from McNary to Priest Rapids Fish Ladders, 2004 & 2005.

Year	McNary	Priest	%
2005	1,850	611	33.0%
2004	1,318	164	12.4%
Mean			22.7%

The mean ascension rates of Ringold origin steelhead above Priest Rapids Dam was 32% for 2004 and 2005. Migration (straying) of Ringold steelhead was considerably lower through the Snake River for these years with less than 1% of the PIT tagged steelhead having been detected at the Ice Harbor fish ladders (Table 18).

Table 18. Comparison of PIT tagged Ringold origin steelhead passage from McNary to Ice Harbor Fish Ladders, 2004 & 2005.

Year	McNary	Ice Harbor	%
2005	1,850	15	0.8%
2004	1,318	11	0.8%
Mean			0.8%

Juvenile salmon and steelhead collected at the McNary Juvenile Fish Facility were transported from McNary Dam downriver to release locations below Bonneville Dam until 2000. SARs can vary dramatically between in-river migrants and transported fish depending on river conditions. Spring migrants, other than research fish, have not been transported from the McNary JJF in recent years and this change will likely influence steelhead survival and must be taken into account when predicting adult returns. Adult return forecasts of RSRF steelhead are currently based on the 1 ocean return of Wells steelhead to the RSRF facility in 1999. This was the only time steelhead returns to the facility were completely enumerated. The goal of the PIT tag study currently underway by NMFS is to compare SARs of juvenile steelhead passage through various routes at McNary Dam (Table 19). These SARs can be used to adjust our forecast of steelhead returns to the Ringold area.

Table 19. Steelhead tagging at Ringold Hatchery for COE Transportation Studies from McNary Dam, 2003 - 2005 (Data provide by Doug Marsh, NMFS).

2003						
Hatchery	Juv group	Juvenile #	1-ocn	2-ocn	Total	SAR
RINH	Bypass	267	2	7	9	3.37
RINH	Full-Flume	3,755	58	61	119	3.17
RINH	Not Detected	56,755	1,198	937	2,135	3.76
RINH	Transported	2,967	63	48	111	3.74
RINH	Unknown	14	-	-	-	-
	Totals	63,758	1,321	1,053	2,374	3.72
2004						
Hatchery	Juv group	Juvenile #	1-ocn	2-ocn	Total	SAR
RINH	Bypass	1,003	13	-	13	1.30
RINH	Full-Flume	4,820	108	-	108	2.24
RINH	Not Detected	86,787	608	-	608	0.70
RINH	Transported	3,871	83	-	83	2.14
RINH	Unknown	13	-	-	-	-
	Totals	96,494	812	-	812	0.84
2005						
Hatchery	Juv group	Juvenile #	1-ocn	2-ocn	Total	SAR
RINH	Bypass	2,164	-	-	-	-
RINH	Full-Flume	7,670	-	-	-	-
RINH	Not Detected	46,485	-	-	-	-
RINH	Transported	4,634	-	-	-	-
RINH	Unknown	18	-	-	-	-
	Totals	60,971	-	-	-	-

WDFW is currently using an SAR of 0.0158 for 1-Ocean and 0.0043 for 2-Ocean returns of Ringold released steelhead. The combined SAR from the NMFS study for steelhead released from Ringold in 2003 and returning to the McNary adult fish ladders was 0.0372, 0.0207 for 1 Ocean and 0.0165 for 2 Ocean returns (Table 20). The SAR of 1-Ocean steelhead in 2004 from the 2003 release was considerably lower at 0.0083. The ratio of 1-Ocean to 2-Ocean returns for the 2002 brood year (2003 release) was radically different from the return ratios for the four years prior (based on steelhead sampled from the harvest). Returns of 1-Ocean steelhead in the harvest had a mean composition of 83% of the returns from 2001 to 2004, compared to only 41% of the return in 2005. Age composition of the return was similar for both PIT tagged groups (ratio of 1-Ocean to 2-Ocean = 44:56) and in the harvest (ratio of 1-Ocean to 2-Ocean = 41:59). SARs used to predict returns of Ringold origin steelhead will not likely be modified until the NMFS study has been completed.

Table 20. Estimated SAR for Ringold PIT tagged steelhead returns to McNary, Release years 2003-05.

Bonneville			
Rel Year	1 Salt	2 Salt	Combined
2003	0.0292	0.0271	0.0562
2004	0.0119		
2005			
Mean	0.0205		
Std SAR	0.0158	0.0043	0.0200
McNary			
Rel Year	1 Salt	2 Salt	Combined
2003	0.0207	0.0165	0.0371
2004	0.0083		
2006			
Mean	0.0145		
Std SAR	0.0158	0.0043	0.0200

PIT tag data revealed one additional piece of useful information about the Ringold steelhead. Ringold origin steelhead are marked (clipped) with both an adipose and right ventral fin clip to identify them from other Upper Columbia River Wells steelhead. The RSRF ventral fin clips are often relatively difficult to distinguish in returning adults. Often the right ventral fin will exhibit only slight stubbing compared to the left ventral fin. Adipose only clipped steelhead have comprised 6% of the catch during the 2003-04 Ringold area steelhead sport fishery, 8% in 2004-05, and 13% in 2005-06. Of the 38 steelhead detected in the creel sample with PIT tags, 7 (18%) of these fish were observed with adipose only clips (no ventral fin clips). A large proportion of these adipose only caught/harvested steelhead that were presumed to be Mid/Upper Columbia or Snake River steelhead are most likely Ringold origin steelhead that have completely regenerated the ventral fin clip or were not clipped prior to release.

Ringold Steelhead Age and Growth

A total of 300 steelhead were sampled during the 2005-06 Ringold steelhead fishery, 28% of the estimated harvest. Information on length, gender, and clips was collected from all steelhead observed during creel interviews. Scale samples were collected at a ratio of 1 in 2, resulting with the collection of 124 scale samples. Only three of the scale samples collected were unreadable (regenerated scales) and 9 hatchery steelhead were adipose clip only and were removed from the age/gender composition analysis. The remaining 112 scale samples were used to estimate age and gender composition of the harvest. The majority of the steelhead harvested in this fishery were 2-salt steelhead (59%), having spent one year in fresh water and two years in the ocean before returning to the Columbia River (Table 21 & Figure 8). This was a departure from prior years where 1-salt steelhead typically dominate the return. No 3-salt fish were sampled and no steelhead had spent more than one year rearing in fresh water. No 3-salt steelhead have been sampled in this fishery since the Ringold Springs Rearing Facility began rearing and releasing Wells stock steelhead (1998). One salt steelhead ranged in size from 52cm to 69cm with an average fork length of 60cm. Males comprised 65% of the 1-salt return. Two salt steelhead averaged 74cm, range 65cm – 82cm, and had a slightly higher percentage of females with a female to male ratio of 55:45. Overall female composition of the harvest was 46%. Gender composition of the catch may be slightly biased towards females as some anglers target on female steelhead to procure eggs for bait. No coded wire or radio tagged fish were sampled in 2005-06 but 38 PIT tagged steelhead were recovered. All PIT tagged fish were Ringold origin steelhead, part of research conducted by the NMFS.

Table 21. Age and gender composition of hatchery steelhead harvested in the Ringold fishery, 2005-06.

	1 salt		2 salt		Total	
	#	%	#	%	#	%
Male	30	65.2%	30	45.5%	60	53.6%
Female	16	34.8%	36	54.5%	52	46.4%
Totals	46	41.1%	66	58.9%	112	

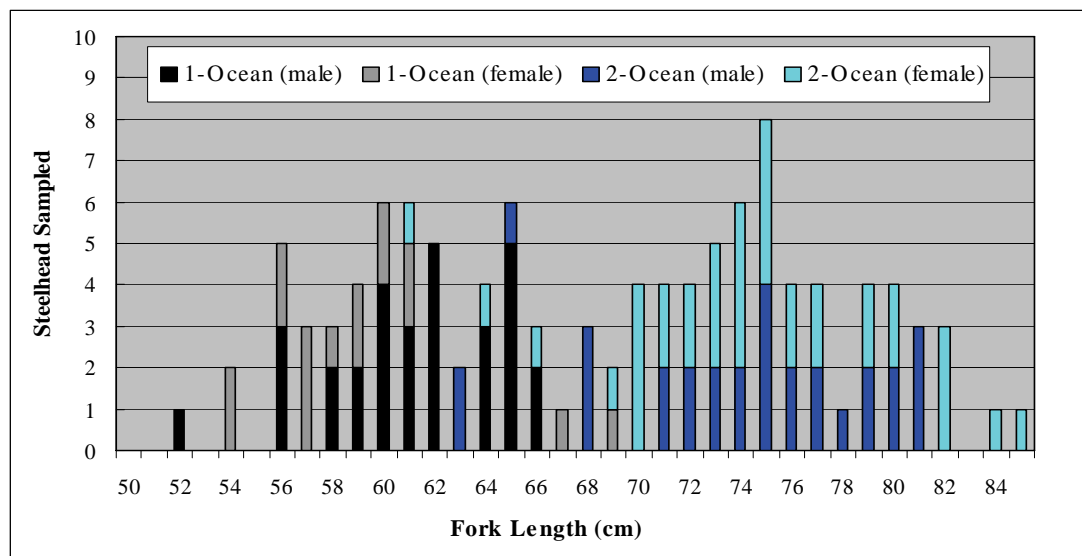


Figure 8. Length frequency and age of hatchery steelhead harvested in the Ringold fishery, October 1, 2005 – April 15, 2006.

Summary

The WDFW District 4 biologist currently forecasts the estimated return of hatchery steelhead to the Ringold Springs Rearing Facility using SARs (smolt adult return ratios) determined from the 1999 hatchery return. Adult steelhead returns in the Columbia and Snake River systems have increased dramatically since 1999. There have been attempts to adjust the Ringold return estimates based on pre-season forecasts for these systems and in-season passage through the fish ladders of Bonneville, McNary, Ice Harbor, and Priest Rapids hydroelectric projects. Unfortunately, the Ringold return does not appear to track well with these predictions or passages. Steelhead passage through Priest Rapids is somewhat correlated but the relation is not significant to warrant adjusting pre-season estimates. The use of ladder counts to estimate the Ringold return (McNary steelhead passage - Ice Harbor - Prosser - Priest Rapids = Ringold) produces wildly variable and unlikely return estimates; 111,000, 67,000, 24,000, and 10,000 for the years, 2001 to 2004 respectively.

The current method to predict hatchery steelhead returns to the Ringold Facility does appear to provide a reasonable estimate of returns to Ringold for three of last five years (Figures 9, 10, and 11). The harvest return estimate illustrated in the figures below is based on an angler harvest of 51% of the return. The mean proportion of harvest to estimated return for 2001-02, 2002-03, and 2004-05 was 51%, range 0.49 - 0.54. There was an unusually high return of 1-salt steelhead and relatively low return of age 2-salt steelhead in the 2003 RSRF return based on the harvest in the sport fishery and the data was not incorporated for this comparison. The harvest of marked (caudal clipped) recycle Ringold origin steelhead was 50% of the marked population during the 2004-05 fishery providing some additional indication that anglers are effective in harvesting roughly 50% of the available steelhead. Comparisons of the two return methods for predicting/evaluating returns indicate that the harvest method may overestimate the population of 2-salt steelhead or the SAR for 2-salt steelhead may be too low.

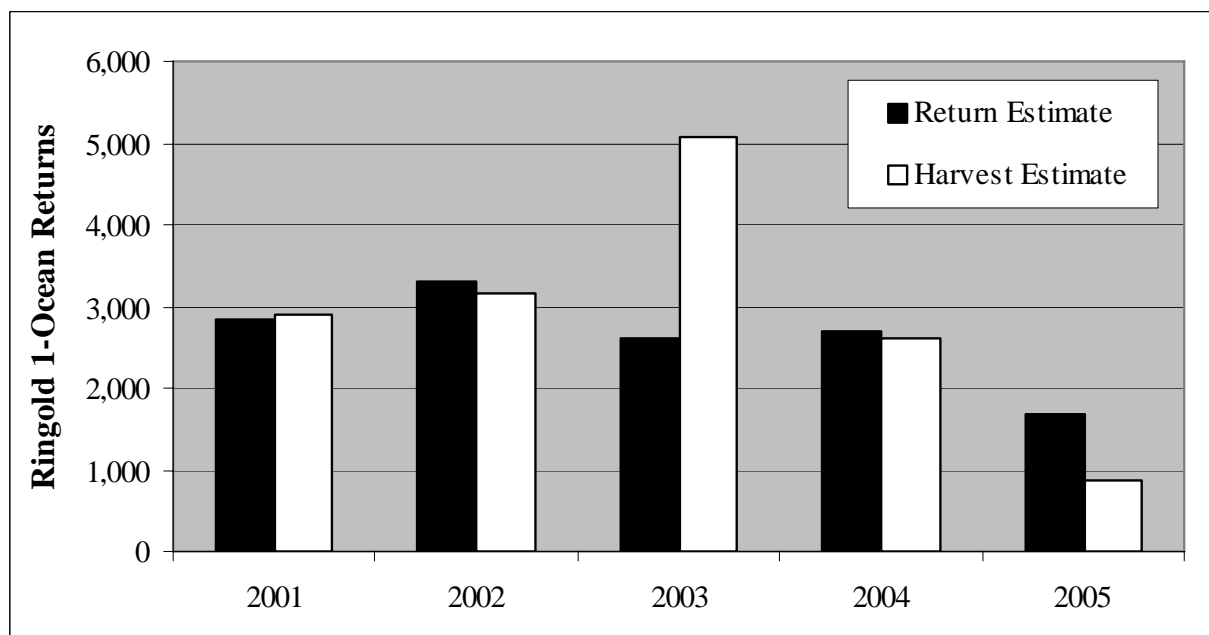


Figure 9. Estimated 1-Ocean steelhead returns to Ringold Springs RF by SAR and from harvest, 2001-05.

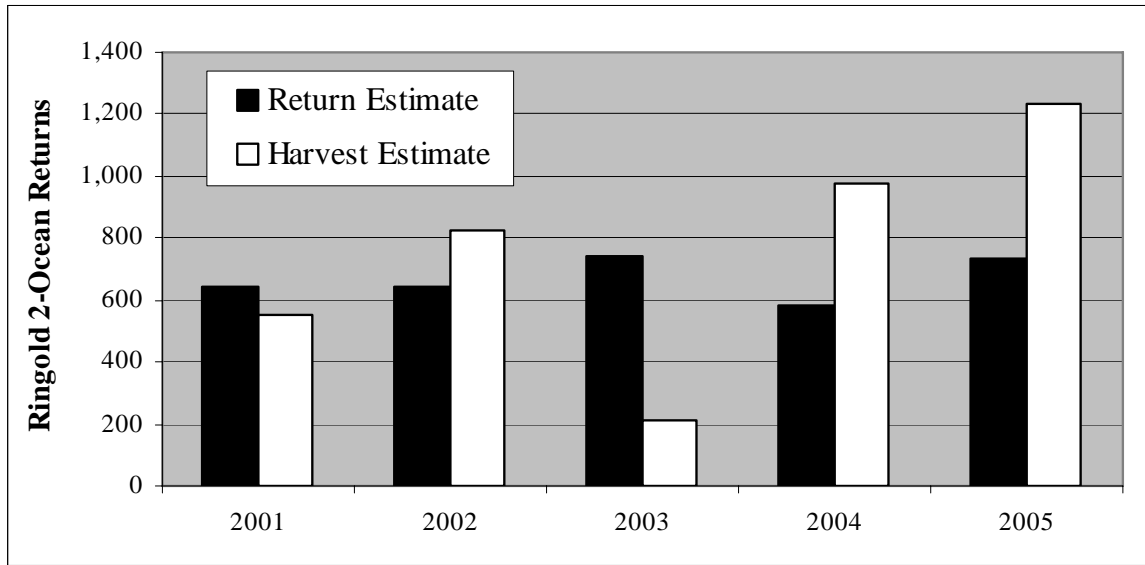
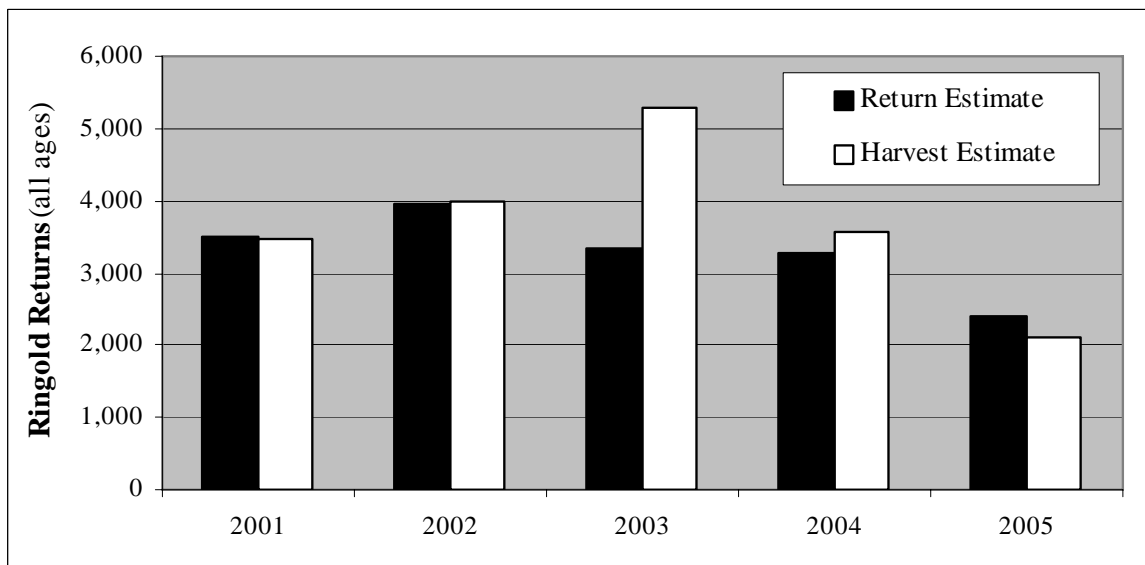


Figure 10. Estimated 2-Ocean steelhead returns to Ringold Springs RF by SAR and from harvest, 2001-05.

Figure 11. Estimated steelhead returns to Ringold Springs RF by SAR and from harvest, 2001-



05.

In general, catch, harvest, and effort during the 2005-06 Ringold steelhead fishery were lower than the prior two seasons. Angler effort for the 2001-02 and 2002-03 fisheries are not comparable as the sport fishery was opened by emergency regulation after October 1. The 2005-06 catch and harvest were the lowest in the past five years (Table 22). Harvest during the 2005-06 season was 41% less than during the 2004-05 fishery and declined 44% from the four year average (1992-2005, mean = 1,905). Angler effort (pole hours) was 15% lower than the 2004-05 fishery and well below the 2003-04 fishery (Table 23). The increase in angler effort reported during the past three seasons can be attributed to the earlier opening of the steelhead fishery in those years and the recent increase in the number of boat anglers utilizing the Ringold launch. The earlier opening on October 1 also coincides with the peak of angler activity for the Hanford Reach fall chinook fishery. No effort was made to separate fall chinook and steelhead anglers as

most anglers are utilizing techniques that will catch either species. Catch and harvest was highest during October, November, and March but the fishery provided good angling opportunity throughout the winter months. The decline in harvest was expected this season as hatchery production was well below 180,000 steelhead (hatchery goal) for both the 2002 and 2003 brood years (2003 and 2004 releases).

Table 22. Estimated harvest of steelhead during the Ringold fishery, 1992-2006.

Wells Stock		Skamania Stock	
Fishery	Harvest	Fishery	Harvest
2005-06	1,069	1999	620
2004-05	1,825	1998	615
2003-04	2,698	1997	1,303
2002-03	1,333	1996	1,678
2001-02	1,764	1995	3,614
2000*	546	1994	2,276
		1993	3,742
		1992	3,634

Table 23. Comparison of monthly angler effort during the Ringold steelhead sport fishery, 2003-04 to 2005-06.

Month	2005-06	2004-05	2003-04
Oct	24,867	28,202	26,869
Nov	3,843	6,577	8,251
Dec	1,052	2,644	2,224
Jan	748	750	1,090
Feb	1,043	959	2,358
Mar	2,804	1,493	3,260
Apr	792	810	1,018
Total	35,148	41,435	45,070

Mean fork length of harvested steelhead was 69 cm in the 2005-06 harvest, well above the norm from the three seasons prior. The increase in mean fork length was due to the unexpected return of a higher than typical proportion of 2-salt steelhead (Table 24). The age composition of the harvest in the 2005-06 fishery was 41% 1-salt steelhead whereas the mean age composition for 1-salt steelhead at RSRF over the prior four years prior was 83%. The female to male ratio was similar to returns for the prior four seasons. Length frequency trends for 1-salt steelhead continue to exhibit a decline in mean fork length though 2-salt steelhead appear to have stabilized at 74cm after declining from 78cm to 72cm from 2002 to 2003. In this fishery, 1-salt steelhead returning to Ringold were typically less than 68cm.

Monitoring during the Ringold area steelhead fishery is funded primarily through WDFW general funds from Region 3 steelhead management. Creel interviews at Vernita Bridge, White Bluffs, and Leslie Groves during the Hanford Reach fall chinook fishery are provided and funded by the Region 5 Coded Wire Tag Recovery Program.

Table 24. Length, age, gender composition of hatchery steelhead harvested in the Ringold

fishery, 2001 – 2006.

Year	2005-06	2004-05	2003-04	2002-03	2001-02
Number Sampled	112	260	635	232	181
Length					
1-Salt (mean: range)	60 cm : 52-69	61 cm : 48-73	62 cm : 50-73	63 cm : 47-79	66 cm : 55-78
2-Salt (mean: range)	74 cm : 61-85	74 cm : 65-82	72 cm : 65-80	78 cm : 69-87	76 cm : 70-89
Overall	69 cm	64 cm	62 cm	66 cm	68 cm
Age Composition					
1-Salt (%)	41.1%	72.7%	95.9%	79.3%	84.0%
2-Salt (%)	58.9%	27.3%	4.1%	20.7%	16.0%
Gender Composition					
1-Salt (% female)	34.8%	50.3%	44.2%	42.9%	47.4%
2-Salt (% female)	54.5%	67.6%	48.0%	72.9%	75.9%
Overall	46.4%	55.0%	44.3%	49.1%	51.9%

Appendix A. Summary statistics and estimated harvest by month for the Ringold steelhead sport

fishery.

October					November					December					January				
	Weekdays		Weekends			Weekdays		Weekends			Weekdays		Weekends			Weekdays		Weekends	
Catch	Bank	Boat	Bank	Boat		Bank	Boat	Bank	Boat		Bank	Boat	Bank	Boat		Bank	Boat	Bank	Boat
Mean	8.62	5.23	7.53	7.14		3.05	4.63	4.61	5.17		0.95	1.96	1.16	2.30		0.18	1.47	0.50	1.26
Standard Error	1.24	2.12	1.71	2.28	7.35	0.65	1.50	2.53	1.80	6.48	0.32	0.95	0.44	0.64	2.35	0.12	1.23	0.50	1.26
# of days	21.00	21.00	10.00	10.00		20.00	20.00	10.00	10.00		21.00	21.00	10.00	10.00		20.00	20.00	10.00	10.00
Catch/Harvest	181.11	109.80	75.26	71.45	438	60.94	92.63	46.14	51.67	251	19.88	41.22	11.56	23.00	96	3.66	29.33	5.00	12.55
Standard Deviation	4.12	7.02	5.41	7.20		2.06	4.73	6.20	4.42		1.00	2.86	0.99	1.43		0.34	3.48	1.00	2.51
Sample Variance	16.96	49.24	29.28	51.86		4.26	22.37	38.43	19.54		1.01	8.19	0.97	2.06		0.12	12.08	1.00	6.30
Harvest Variance S6	323.85	940.03	0.00	0.00	1263.88	85.19	447.31	256.18	130.29	918.97	23.24	229.35	9.75	20.56	283	3.48	362.39	15.00	94.52
SS	967.80	793.10	830.00	977.20		131.20	415.80	319.90	257.90		18.00	100.20	10.60	34.70		1.10	101.80	4.00	25.20
Sum (same as below)	94.87	57.51	75.26	71.45		30.47	46.31	27.69	31.00		9.47	17.67	5.78	11.50		1.46	11.73	2.00	5.02
Variance S4	16.95995	49.23843	29.28046	51.86026		4.260952	22.36533	38.42874	19.54598		1.004191	8.190114	0.978492	2.062279		0.118853	12.08462	1.6299538	
Range	14.76	19.12	17.29	20.57		6.88	12.02	16.63	9.22		2.96	6.94	2.72	3.40		0.80	10.01	2.00	5.02
Minimum	2.36	0.00	1.73	0.00		0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.91		0.00	0.00	0.00	0.00
Maximum	17.12	19.12	19.03	20.57		6.88	12.02	16.63	9.22		2.96	6.94	2.72	4.32		0.80	10.01	2.00	5.02
Sum	94.87	57.51	75.26	71.45		30.47	46.32	27.69	31.00		9.47	17.67	5.78	11.50		1.46	11.73	2.00	5.02
Count	11.00	11.00	10.00	10.00		10.00	10.00	6.00	6.00		10.00	9.00	5.00	5.00		8.00	8.00	4.00	4.00